

**Claims**

1. A method of adapting signal processing characteristics of a portable communication device to a hearing impaired user, comprising the steps of
  - determining a perceptual reference level (PRL) of a first stimuli signal (FSS) in a reference frequency band (RFB) by presenting said first stimuli signal (FSS) to said hearing impaired user, and obtaining perceptual judgements of a loudness of said first stimuli signal (FSS) from said hearing impaired user, and
  - determining said perceptual reference level (PRL) of a second stimuli signal (SSS) in a further frequency band (FFB) by presenting said second stimuli signal (SSS) to said hearing impaired user, and requesting said hearing impaired user to compare a loudness of said second stimuli signal (SSS) with said loudness of said first stimuli signal (FSS).
2. A method of adapting signal processing characteristics of a portable communication device according to claim 1, wherein said portable communication device is a hearing aid.
3. A method of adapting signal processing characteristics of a portable communication device according to claim 1 or claim 2, wherein said portable communication device comprises compensation means for compensation of hearing loss.
4. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 3, wherein a most comfortable level (MCL) is used for said perceptual reference level (PRL).
5. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 4, wherein an uncomfortable level (UCL) is used for said perceptual reference level (PRL).

6. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 5, wherein said first stimuli signal (FSS) comprises periodic signals and / or frequency band limited noise.

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7. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 6, wherein said first stimuli signal (FSS) comprises a sound.

10 8. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 7, wherein said first stimuli signal (FSS) comprises a sequence of sounds.

9. A method of adapting signal processing characteristics of a portable  
15 communication device according to any of the claims 1 to 8, wherein said sound is a test word.

10. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 9, wherein said test word  
20 has a spectral energy content of which an effective part is within said reference frequency band (RFB).

11. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 10, wherein said test word  
25 is chosen according to the everyday of said hearing impaired user.

12. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 11, wherein said reference frequency band (RFB) is a sub-band of the audible frequency band.

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13. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 12, wherein said reference frequency band (RFB) is a sub-band of the frequency band from 100 Hz to 10 kHz.

5 14. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 13, wherein said reference frequency band (RFB) has a width of 1,5 octave.

10 15. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 14, wherein said reference frequency band (RFB) has a width of one octave.

15 16. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 15, wherein said reference frequency band (RFB) has a width of  $2/3$  octave.

17. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 16, wherein said reference frequency band (RFB) has a width of  $1/3$  octave.

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18. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 17, wherein said reference frequency band (RFB) is the band from 500 Hz to 1 kHz.

25 19. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 18, wherein said reference frequency band (RFB) is the band from 250 Hz to 800 Hz.

30 20. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 19, wherein said obtaining perceptual judgements of a loudness of said first stimuli signal (FSS) from said

hearing impaired user, comprises the step of letting the user vary the sound pressure level (SPL) of the first stimuli signal (FSS) until said perceptual reference level (PRL) is achieved.

- 5 21. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 20, wherein said second stimuli signal (SSS) comprises periodic signals and / or frequency band limited noise.
- 10 22. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 21, wherein said second stimuli signal (SSS) comprises a sound.
- 15 23. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 22, wherein said second stimuli signal (SSS) comprises a sequence of sounds.
- 20 24. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 23, wherein said sound of said second stimuli signal (SSS) is a test word.
- 25 25. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 24, wherein said test word of said second stimuli signal (SSS) has a spectral energy content of which an effective part is within said further frequency band (FFB).
- 30 26. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 25, wherein said test word of said second stimuli signal (SSS) is chosen according to the everyday of said hearing impaired user.

27. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 26, wherein said second stimuli signal (SSS) is of a kind similar to said first stimuli signal (FSS).

5 28. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 27, wherein said further frequency band (FFB) is a sub-band of the audible frequency band.

10 29. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 28, wherein said further frequency band (FFB) is a sub-band of the frequency band from 100 Hz to 10 kHz.

15 30. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 29, wherein said further frequency band (FFB) is different from said reference frequency band (RFB).

31. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 30, wherein said step of  
20 determining said perceptual reference level (PRL) of a second stimuli signal (SSS) in a further frequency band (FFB) by presenting said second stimuli signal (SSS) to said hearing impaired user, and requesting said hearing impaired user to compare a loudness of said second stimuli signal (SSS) with said loudness of said first stimuli signal (FSS),

25 is repeated with several substantial mutually exclusive said further frequency bands.

32. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 31, wherein said further frequency band (FFB) has a width of 1,5 octave.

33. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 32, wherein said further frequency band (FFB) has a width of one octave.
- 5 34. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 33, wherein said further frequency band (FFB) has a width of  $2/3$  octave.
- 10 35. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 34, wherein said further frequency band (FFB) has a width of  $1/3$  octave.
- 15 36. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 35, wherein said further frequency band (FFB) is the band from 100 Hz to 500 Hz.
- 20 37. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 36, wherein said further frequency band (FFB) is the band from 250 Hz to 500 Hz.
- 25 38. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 37, wherein said further frequency band (FFB) is the band from 1 kHz to 2 kHz.
- 30 39. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 38, wherein said further frequency band (FFB) is the band from 2 kHz to 4 kHz.
40. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 1 to 39, wherein said

comparing a loudness of said second stimuli signal (SSS) with said loudness of said first stimuli signal (FSS), is performed to establish equal loudness.

41. A method of adapting signal processing characteristics of a portable communication device to a hearing impaired user, comprising the steps of

- evaluating a hearing impairment of said hearing impaired user by presenting at least one stimuli signal (SS) to said hearing impaired user, and obtaining perceptual judgements of a predetermined attribute of said at least one stimuli signal (SS) from said hearing impaired user, and
- adjusting said signal processing parameters of said portable communication device according to said perceptual judgements of said at least one stimuli signal (SS);

whereby said at least one stimuli signal (SS) comprises a set of test words, said test words each having a spectral energy content of which the effective part is within one restricted frequency band selected from a set of restricted frequency bands.

42. A method of adapting signal processing characteristics of a portable communication device according to claim 41, wherein said portable communication device is a hearing aid.

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43. A method of adapting signal processing characteristics of a portable communication device according to claim 41 or 42, wherein said portable communication device comprises compensation means for compensation of hearing loss.

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44. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 43, wherein said test word is chosen according to the everyday of said hearing impaired user.

45. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 44, wherein said restricted frequency band is a sub-band of the audible frequency band.
- 5 46. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 45, wherein said restricted frequency band has a width of 1,5 octave.
47. A method of adapting signal processing characteristics of a portable  
10 communication device according to any of the claims 41 to 46, wherein said restricted frequency band has a width of one octave.
48. A method of adapting signal processing characteristics of a portable  
15 restricted frequency band has a width of  $2/3$  octave.
49. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 48, wherein said  
20 restricted frequency band has a width of  $1/3$  octave.
50. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 49, wherein said restricted frequency band is the band from 500 Hz to 1 kHz.
- 25 51. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 50, wherein said restricted frequency band is the band from 250 Hz to 800 Hz.
52. A method of adapting signal processing characteristics of a portable  
30 communication device according to any of the claims 41 to 51, wherein said restricted frequency band is the band from 100 Hz to 500 Hz.



53. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 52, wherein said restricted frequency band is the band from 250 Hz to 500 Hz.

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54. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 53, wherein said restricted frequency band is the band from 1 kHz to 2 kHz.

10 55. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 54, wherein said restricted frequency band is the band from 2 kHz to 4 kHz.

15 56. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 55, wherein said obtaining perceptual judgements of a predetermined attribute of said at least one stimuli signal (SS) from said hearing impaired user, comprises the step of letting said user vary said predetermined attribute until a predetermined perceptual level is achieved.

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25 57. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 56, wherein said step of evaluating a hearing impairment of said hearing impaired user by presenting at least one stimuli signal (SS) to said hearing impaired user, and obtaining perceptual judgements of a predetermined attribute of said at least one stimuli signal (SS) from said hearing impaired user, is repeated with several substantial mutually exclusive said restricted frequency bands.

58. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 57, wherein said hearing impaired user is presented with at least two stimuli signals (SS).

5 59. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 58, wherein said predetermined attribute is a perceptual hearing level.

10 60. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 59, wherein said predetermined attribute is consonant discrimination.

15 61. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 60, wherein said predetermined attribute is intelligibility.

62. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 61, wherein said predetermined attribute is clarity.

20 63. A method of adapting signal processing characteristics of a portable communication device according to any of the claims 41 to 62, wherein said obtaining perceptual judgements of a predetermined attribute of said at least one stimuli signal (SS) from said hearing impaired user, is repeated with a further  
25 predetermined attribute.